Staffing Patterns of the National Institutes of Health Research Grants

National Institutes of Health
Office of the Director

Staffing Patterns of the National Institutes of Health Research Grants

---

Office of Science Policy and Legislation

March 1993

FOR ADMINISTRATIVE USE ONLY
National Institutes of Health
Public Health Service
U.S. Department of Health and Human Services

Contents

Executive Summary 1

Background 3

Approaches Used in the Data Collection and Analysis 5
Findings: Staffing Patterns 5
Findings: Costs of Research Grants 9

Summary 21

Appendix: Methodology 23

Executive Summary

The Office of Management, in the Passback for the Fiscal Year (FY) 1992 NIH Budget, requested estimates of the number of differing types of scientists (e.g., Principal Investigators, pre- and postdoctorate individuals) supported in current and past grant applications. The estimates were developed from 5 percent proportionate random samples of new (Type 1) and competing renewal (Type 2) investigator-initiated research grants (R01) and program project grants (P01) in the NIH portfolio for FY 1983, FY 1985, FY 1987, and FY 1990. In addition to an assessment of staffing patterns, the study also examined the pattern of costs associated with these grants, particularly those associated with personnel, in order to test the validity of the belief that grant costs have increased because of the changing nature of the composition of grants.

Data were obtained from individual grant files. They permitted estimates of the number of full-time equivalents (FTEs) employed in various personnel categories, the extent to which individuals were likely to be in a training phase of career development, and obligations associated with various budget categories.

Study results show that

- The estimated number of FTEs supported by NIH funds increased from 47,895 in FY 1983 to 55,656 in FY 1985, dropped to 53,858 in FY 1987, and subsequently rose to 55,480 in FY 1990. The estimated average FTEs per grant increased from 2.99 to 3.25, dropped to 3.06, and rose to 3.33 in the same period.

- Over the years, there were small changes in estimated FTEs for Principal Investigators (PIs) (from .34 FTE per grant to .37). Estimated FTEs for more senior doctorates increased (from .84 FTE per grant to 1.08). Major growth occurred for individuals in the postdoctoral training phase of their careers (from .05 estimated FTE per grant to .40). There were simultaneous decreases in the estimates for Technical Support (from .66 FTE per grant to .46) and Other (from .15 FTE per grant to .13) personnel categories.

- Estimates of FTEs supported by NIH funds for individuals in the predoctoral phase of career development increased nonmonotonically from 4,580 in FY 1983 to 6,762 in FY 1990, representing an increase from 10 percent of the total estimated FTEs in FY 1983 to 12 percent in FY 1990.

- Estimates of FTEs supported by NIH funds for individuals in the postdoctoral phase of career development increased from 811 in FY 1983 to 6,429 in FY 1990, representing an increase from 2 percent of the total estimated FTEs supported in FY 1983 to 12 percent in FY 1990. These estimates are suggestive rather than definitive because the classification definitions were arbitrary and because a substantial number of cases could not be classified.

- Total **direct costs** awarded, expressed in current dollars, increased faster for R01s than for P01s. Between FY 1983 and FY 1990 there was a 53 percent increase in **current dollars** awarded for R01s and a 28 percent increase for P01 grants. Still, the purchasing power of the research dollar has been eroding. Total direct costs awarded, expressed in **constant dollars**, declined since FY 1985 for the R01s, and since FY 1983 for the P01s.

- Personnel costs were the single most important factor in the overall budget increases recorded. Compensation for PIs, without a concomitant increase in effort, was a driving factor.

This study was initiated under the guidance of Dr. Norman S. Braveman and was conducted jointly with the Office of Extramural Research. Special thanks go to Mr. Geoffrey E. Grant, Director, Grants Policy Office, as the study would have been impossible to conduct without his participation. Appreciation also goes to the grants management officers of the Institutes, Centers, and Divisions, who collected and verified the data at the worst possible time of year for them. The report was prepared by Dr. David Chananie.

Background

This study was conducted jointly by the Office of Science Policy and Legislation and the Office of Extramural Research in response to issues raised in the Office of Management and Budget (OMB) Passback for the FY 1992 NIH Budget. Specifically, NIH was asked to conduct **"...a data collection effort on the numbers of researchers (as opposed to just PIs) supported....Such an effort should develop estimates for the number of differing types of researchers (PIs, Co-PIs, post-docs, pre-docs, etc.) proposed to be supported in current and past grant applications, with some subset compared with the actual positions supported on some funded grants. To test the validity of the belief that one reason grant costs have skyrocketed is due to the changing (and more expensive) nature of the composition of grants, samples of applications over time should be compared...."**

The first objective of the study was to describe the staffing patterns on investigator-initiated research grants (R01s and P01s) between FY 1983 and FY 1990. Specifically, three questions about staffing patterns were addressed. First, what is the distribution of full-time equivalents (FTEs) among personnel comprising the workforce supported by NIH-funded grants? Second, how many FTEs supported by these grants are apportioned to individuals at pre- and postdoctoral training phases of their careers? Third, at what level of effort have individuals in all personnel categories been supported? These questions are answered based on information from Institutes' grants files at the time of the award. Subsequent expenditures can be obtained only by direct queries to the recipient institutions themselves. Such queries were beyond the scope of this investigation, given the time and resources available to this project. Further, it is important to note that results apply only to regular research grants and to program projects which together comprise roughly 65 percent of NIH's extramural portfolio.

The second objective of the study was to assess changes in the costs of supporting research grants. Three questions were addressed. First, what are the trends of total direct costs awarded for R01 and P01 research grants between FY 1983 and FY 1990, both in terms of constant and current dollars? Second, what factors contributed to this pattern? Third, have changes in the various personnel categories and subcategories contributed to the pattern?

Approaches Used in the Data Collection and Analysis

A 5 percent proportionate random sample of competing investigator-initiated grants (R01s and P01s) was selected for Fiscal Year (FY) 1983, FY 1985, FY 1987, and FY 1990. Grant awards in the initial year of funding (Type 1) as well as those funded following competitive renewal (Type 2) were included in the study. Requested and awarded levels of effort, salaries, equipment, supplies, travel, and other costs were recorded from grant files maintained in Institute, Center, or Division (ICD) grants management offices. In addition, the number of different individuals employed in each of five staff categories (Principal Investigator, Other Doctorates, Other Research Support, Technical Support, and Other) was recorded. The decision was made to focus on FTEs supported, rather than on individuals supported, because there was no way to ensure that double counting of individuals associated with multiple grants would not compromise the accuracy of the estimates. FTEs, in contrast, would be unaffected by this problem. Further, FTE calculations have the advantage that they weight individuals by the extent of their work effort rather than counting all individuals equally. Donations of effort at no cost to the Government were recorded. This provides a more realistic estimate of the level of effort being supported by the NIH.

FINDINGS: STAFFING PATTERNS

What is the distribution of FTEs in the workforce on NIH-funded grants?

Estimates of FTEs[1] for the entire workforce supported on NIH grants are summarized in Table 1.

The estimates are based on all grants made for a fiscal year and thus include noncompeting renewals. Historically, noncompeting renewals tend to request a greater percentage of the overall budget for personnel costs (68 percent in FY 1990) than do new awards (51 percent in

[1] Overall estimates were calculated by multiplying the average number of FTEs per type of grant by the number of R01 and P01 grants funded in a given fiscal year; the number of grants funded in a given fiscal year were obtained from the NIH Data Book. Resultant totals were then combined to obtain overall estimates for the R01 and P01 grants. Estimates of the number of FTEs in each personnel category were then calculated by multiplying the overall estimate for a fiscal year by the average percentage of FTEs in the staff category as determined by the sample for that fiscal year.

FY 1990) or competing continuation awards (65 percent in FY 1990), but these higher costs may or may not reflect increased effort.[2] There is reason to believe, however, that actual expenditures rebudget funds away from personnel towards supplies and equipment, by 9 percent for Type 1

Table 1
Estimated Total Number of Full-Time Equivalents (FTEs) and Average Full-Time Equivalents Per Grant for NIH R01 and P01 Grant-Supported Workforce by Staff Category

	FY 1983	FY 1985	FY 1987	FY 1990
TOTAL NUMBER OF FTEs FOR ALL GRANTS	47,896	55,657	53,858	55,480
PI	5,914	5,779	6,332	5,898
Other Docs.	13,358	16,532	17,431	18,047
Other Res. Suppt.	15,339	20,046	18,583	21,553
Technical Suppt.	10,487	10,329	9,149	7,693
Other	2,471	2,929	2,277	2,247
Unclassifiable	327	42	86	42
NUMBER OF GRANTS	15,995	17,134	17,603	16,659
AVERAGE FTEs PER GRANT	2.99	3.25	3.06	3.33
PI	0.37	0.34	0.36	0.35
Other Docs.	0.84	0.96	0.99	1.08
Other Res. Suppt.	0.96	1.17	1.06	1.29
Technical Suppt.	0.66	0.60	0.52	0.46
Other	0.15	0.17	0.13	0.13
Unclassifiable	0.02	0.00	0.00	0.00

[2] *Extramural Trends FY 1981-1990,* Division of Research Grants, National Institutes of Health, July 1991, p. 64.

awards, and 6 to 7 percent for noncompeting renewals.[3] This view is most recently bolstered by results of the Department of Health and Human Services (HHS) Inspector General's examination of 100 research projects. The report showed: "Generally, cost categories labeled personnel, other and travel were underspent while cost categories labeled supply, equipment and consultant were overspent. Government regulations currently permit the practice of shifting expenditures between budget line items. We also found that in many cases funds awarded are not used during the budget period and are carried forward to the next award period."[4]

The report further notes: "Department of Health and Human Services (HHS) policy and regulations based on the Office of Management and Budget (OMB) Circular A-110 preclude Public Health Service (PHS) awarding agencies, such as NIH, from requiring periodic, detailed, line-item expenditure reports from its grantees. Therefore, NIH has little specific information as to how its funds are actually used and whether the actual use of the funds supported the scope of research approved by its peer review committees." Although no one knows what is actually occurring, the estimates based on the Type 1 and Type 2 data gathered in this study are arguably as reasonable as any.

The table shows that in terms of total FTEs, the grant-supported workforce rose in FY 1985, dropped in FY 1987, and increased again by FY 1990. A monotonic increase in FTEs associated with Other Doctorates (up 35 percent from FY 1983 to FY 1990) and an overall increase in FTEs associated with Other Research Support (up 41 percent) are evident. The biggest increase in total FTEs occurred between FY 1983 and FY 1985. Increases of approximately .27 FTEs per grant occurred between FY 1983 to FY 1985 and between FY 1987 and FY 1990. There has, however, been a decline in FTEs associated with Technical Support and Other personnel categories. In terms of average FTE per grant, PIs have continued to work at about the same level of effort, more emphasis has been placed on Other Doctorates, and more effort has been placed on Other Research Support. The average FTE for the Technical Support and Other personnel categories declined.

---

[3] *Comparison of Award Versus Expenditure for Direct Costs: A Sample of 840 R01 Grants from Eight Institutions for Fiscal Year 1985*, Office of Science Policy and Legislation, National Institutes of Health, September 1989.

[4] *Management Advisory Report: Actual Expenditures of National Institutes of Health Research Funds Were Generally Unknown (A-06-91-00073)*, draft report, undated.

How many FTEs at the pre- and postdoctoral level of career development are being supported by NIH research grants?

For purposes of this analysis, individuals at the predoctoral level of career development were defined as those who satisfied any one of the following three criteria: (a) the individual was listed explicitly as a predoctoral assistant or as a trainee; (b) there was a written statement that his or her tuition was reimbursed from grant funds; or (c) the position description indicated that an individual at the predoctoral career level would be used to fill a research position.

To determine the number of individuals at the postdoctoral level of career development, all individuals in the Other Doctorates category were further classified by the number of years since obtaining the first terminal degree. To remain consistent with definitions used for other NIH grant mechanisms, individuals with 7 or fewer years were defined as being at the postdoctoral level of career development. Those with more than 7 years of experience after getting the first terminal doctoral degree were considered to be independent scientists collaborating on a grant.

This bifurcation is arbitrary in certain respects. Some individuals who have been out for less than 7 years since the doctorate will have attained independent researcher status, while others more than 7 years out may still be in a training position, particularly if recent Ph.D.s have increasingly been taking more than one postdoctorate position. Further, in 18 to 21 percent of the cases, information on time since degree was unavailable. Because of these limitations, the results are suggestive rather than definitive.

Table 2 presents the estimated number of FTEs for pre- and postdoctorate individuals. These estimates were derived by multiplying the total number of grants in a particular fiscal year by the average FTE per grant from the study sample for a given personnel category for that fiscal year. For example, the estimate of 4,580 for predoctorate individuals in FY 1983 was obtained by multiplying the 15,995 grants funded in FY 1983 by the .29 for predoctorate individuals in FY 1983.

Predoctorates increased nonmonotonically from 4,580 FTEs in FY 1983 to 6,762 FTEs in FY 1990 (from 10 percent of the total FTEs supported to 12 percent). The number of postdoctorate FTEs monotonically increased from 811 in FY 1983 to 6,429 in FY 1990, representing an increase from 2 percent of the FTEs supported in FY 1983 to 12 percent in FY 1990. The growth in FTEs showed increased reliance on postdoctorate individuals, and to a lesser extent predoctorate individuals, to carry out research.

Table 2
Estimated Total FTEs for Pre- and Postdoctorates and Average Full-Time Equivalents per Grant in the NIH R01 and P01 Grant-Supported Workforce

	FY 1983	FY 1985	FY 1987	FY 1990
TOTAL	47,895	55,656	53,859	55,480
Subtotal	**5,392**	**10,106**	**9,005**	**13,191**
Predoctorates	4,580	7,774	5,242	6,762
Postdoctorates	811	2,331	3,763	6,429
AVERAGE	2.99	3.25	3.06	3.33
Subtotal	**0.34**	**0.59**	**0.51**	**0.79**
Predoctorates	0.29	0.45	0.30	0.41
Postdoctorates	0.05	0.14	0.21	0.39

One may question the reliability of the growth rate in NIH-supported postdoctorates between FY 1983 and FY 1990, particularly the jumps between FY 1983 and FY 1985 and FY 1987 and FY 1990. The Graduate Students and Postdoctorates in Science and Engineering Survey (GSPSE) is a jointly funded effort by the National Institutes of Health and the National Science Foundation to collect universities' headcount data on their science graduate students and postdoctorates. The GSPSE showed a growth of full-time graduate students in the biological and health sciences supported by NIH grants from 3,360 in FY 1983, 3,846 in FY 1985, 4,897 in FY 1987, to 6,108 in FY 1990. The GSPSE never obtained sources of support for postdoctorates, so figures on NIH-supported postdoctorates are unavailable. The total number of postdoctorates in the biomedical sciences, however, based on this enumeration, rose from 5,987 in FY 1983 to 11,043 in FY 1990. Thus, the large increase in the growth of predoctorates and postdoctorates, despite any noise in the FTE estimates, is independently supported.

FINDINGS: COSTS OF RESEARCH GRANTS

The second set of questions addresses the request from OMB that NIH **"...test the validity of the belief that one reason grant costs have skyrocketed is due to the changing (and more expensive) nature of the composition of grants...."** This was done by examining the direct costs of research grants over the 8-year timeframe of the study, identifying factors

that contribute to changes in costs, and exploring influences of changes in personnel costs on total direct costs.

What have been the trends in total direct costs awarded for NIH research grants?

Figures 1 and 2 summarize the average total direct costs awarded for grants in the study sample, in both current and constant dollars. Current dollar awards associated with R01s increased by approximately 53 percent over the timeframe of the study for an average annual rate of approximately 7 percent. The average annual increase was reduced to less than 1 percent when award amounts were translated into constant dollars using the Biomedical Research and Development Price Index (BRDPI). By this measure the purchasing power for R01 research has declined since 1985.

Average direct costs of P01 grants showed an overall increase in current dollars of 28 percent (4 percent on an average annual basis), a rate of increase substantially less than the 53 percent for the R01s. When awards were measured in constant dollars, there was an overall decline between FY 1983 and FY 1990. For both R01 and P01 grants, the decline was approximately 10 percent.

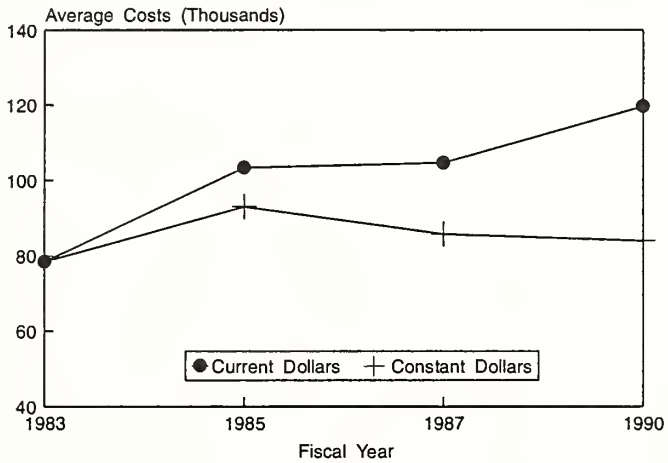
What factors have contributed to this pattern?

Analysis of factors that contributed to the changes in direct costs awarded focused on the nine budget categories used in typical NIH grants (Personnel, Equipment, Supplies, Travel, Other, Consortium, Consultants, Patient Care, and Alterations/Renovations). Table 3 shows the average total direct costs awarded, in current and constant dollars, for R01 grants and Table 4 shows the parallel figures for P01 grants.

A number of analyses were done on these data, including: (1) determining the percent of the overall change (either an increase or decrease in the total) between time periods attributed to a change in a given budget category, (2) examining change rates between time periods for a given budget category, and (3) calculating the percentage of the overall budget attributable to a given budget category for each fiscal year. The different approaches yield much the same interpretations. The third approach was chosen for simplicity of presentation, and the results are shown in Table 5.

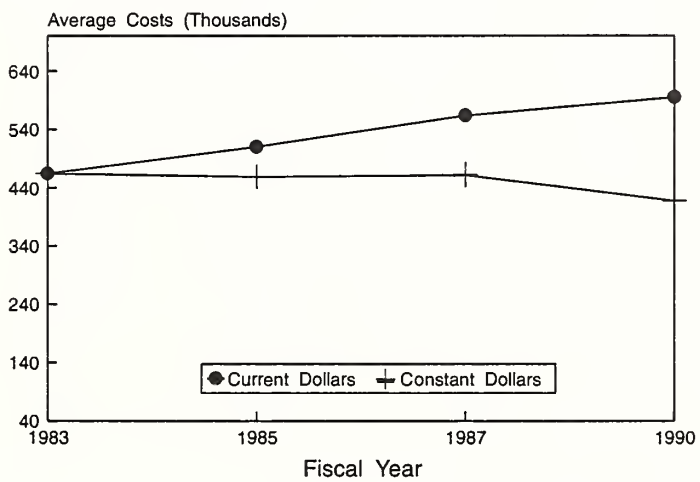
Personnel costs were the largest percentage of direct costs initially, and remained so. In current dollars, increases in personnel costs are the largest driver of increases in total direct costs for both R01 and P01 grants.

Figure 1. Average Total Direct Costs Awarded for R01 Grants in Study Sample



Source: Totals Computed from NIH/DRG
IMPAC file and Grants Management Files
Constant Dollars with BRDPI @ 1983 base.

Figure 2. Average Total Direct Costs Awarded for P01 Grants in Study Sample



Source: Totals Computed from NIH/DRG
IMPAC file and Grants Management Files
Constant Dollars with BRDPI @ 1983 base.

Table 3
Average Total Direct Costs Awarded for Type 1 and Type 2 R01 Grants

Current Dollars

	FY 1983	FY 1985	FY 1987	FY 1990
TOTAL	78,415	103,365	104,632	119,665
Personnel	51,426	66,964	69,297	80,256
Equipment	8,239	13,148	8,992	9,350
Supplies	10,501	13,928	14,634	16,845
Travel	1,091	1,456	1,447	1,607
Other	4,871	6,028	6,137	7,239
Consortium	2,112	1,259	3,391	3,703
Consultants	171	258	611	350
Patient Care	4	284	123	315
Alterations	0	40	0	0

Constant Dollars

	FY 1983	FY 1985	FY 1987	FY 1990
TOTAL	78,415	92,986	85,724	83,956
Personnel	51,426	60,241	56,775	56,307
Equipment	8,239	11,828	7,367	6,560
Supplies	10,501	12,530	11,990	11,818
Travel	1,091	1,310	1,186	1,127
Other	4,871	5,423	5,028	5,079
Consortium	2,112	1,132	2,778	2,598
Consultants	171	232	500	246
Patient Care	4	256	100	221
Alterations	0	36	0	0

In constant dollars with BRDPI @ 1983 base of 1.00, 1985 = .8996, 1987 = .8193, and 1990 = .7016.

Table 4
Average Total Direct Costs Awarded for Type 1 and Type 2 P01 Grants

Current Dollars

	FY 1983	FY 1985	FY 1987	FY 1990
TOTAL	464,270	509,902	563,466	594,606
Personnel	285,114	319,273	356,404	368,933
Equipment	15,532	47,641	46,731	60,362
Supplies	64,451	73,219	62,644	76,698
Travel	5,638	6,317	5,627	9,467
Other	27,457	27,506	26,162	36,971
Consortium	4,461	31,238	59,213	32,590
Consultants	1,396	1,333	3,590	5,262
Patient Care	59,530	3,375	1,890	1,418
Alterations	691	0	1,205	2,905

Constant Dollars

	FY 1983	FY 1985	FY 1987	FY 1990
TOTAL	464,270	458,707	461,646	417,176
Personnel	285,114	287,218	292,002	258,843
Equipment	15,532	42,858	38,287	42,350
Supplies	64,451	65,867	51,324	53,812
Travel	5,638	5,683	4,610	6,642
Other	27,457	24,744	21,434	25,939
Consortium	4,461	28,102	48,513	22,865
Consultants	1,396	1,199	2,941	3,692
Patient Care	59,530	3,036	1,548	995
Alterations	691	0	987	2,038

In constant dollars with BRDPI @ 1983 base of 1.00, 1985 = .8996, 1987 = .8193, and 1990 = .7016.

Table 5
Budget Allocation by Fiscal Year and Type of Grant

	Percent of Fiscal Year Budgets for R01 Grants			
	1983	1985	1987	1990
TOTAL	100%	100%	100%	100%
Personnel	66%	65%	66%	67%
Equipment	11%	13%	9%	8%
Supplies	13%	13%	14%	14%
Travel	1%	1%	1%	1%
Other	6%	6%	6%	6%
Consortium	3%	1%	3%	3%
Consultants	0%	0%	1%	0%
Patient Care	0%	0%	0%	0%
Alterations	0%	0%	0%	0%

	Percent of Fiscal Year Budgets for P01 Grants			
	1983	1985	1987	1990
TOTAL	100%	100%	100%	100%
Personnel	61%	63%	63%	62%
Equipment	3%	9%	8%	10%
Supplies	14%	14%	11%	13%
Travel	1%	1%	1%	2%
Other	6%	5%	5%	6%
Consortium	1%	6%	11%	5%
Consultants	0%	0%	1%	1%
Patient Care	13%	1%	0%	0%
Alterations	0%	0%	0%	0%

The representation of equipment costs has declined since FY 1985 for R01 grants and risen since FY 1983 for P01 grants. Patient care costs have vanished for P01 grants.

To what degree have changes in various personnel categories and subcategories contributed to this pattern?

Changes in personnel costs are largely responsible for overall increases in total direct costs. A measure was derived to compare directly cost changes across personnel categories. The measure is termed the **unit cost of effort** and expresses how much it costs to buy 1 percent of a person's effort.

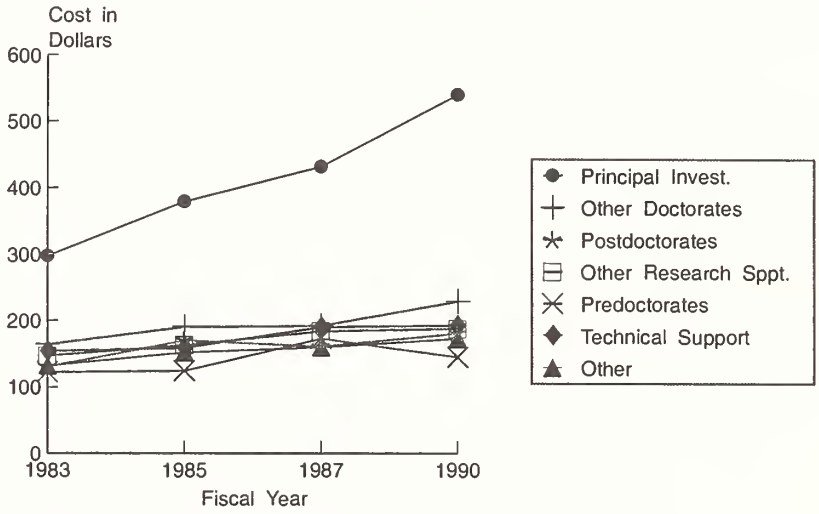
The unit cost of effort is calculated by dividing an individual's budgeted cost by his or her corresponding percent effort. For example, if a principal investigator contributes 30 percent effort to a grant or subproject at a cost of $18,000, the cost of each unit of effort for that individual, or the unit cost of effort, is $600 (i.e., $18,000/30). Similarly, if an individual within the Other Doctorates category contributes 50 percent effort at a cost of $10,000, the unit cost of effort is $200 (i.e., $10,000/50), or one-third of that for the PI. The percent of volunteer effort of individuals (such as PIs, other senior staff, or NRSA grantees) who donated their time to a research project at no cost was recorded as zero cost. Thus, their unit cost of effort was zero.

Figures 3 and 4 show the results, expressed in current dollars, for R01 and P01 grants, respectively.

The unit cost of effort for PIs is substantially higher than for any other category, and is higher on P01s than on R01s. More than two-thirds of the PIs on P01s in 1983, 1985, and 1987 were M.D.s or M.D./Ph.D.s; the figure dropped to 64 percent in 1990.[5] If M.D.s in general receive higher remuneration than Ph.D.s, then the preponderance of M.D.s as PIs on P01s would be one possible explanation for the difference in the unit cost of effort. Another possibility is that the PIs of P01 grants are at a higher academic rank than PIs for R01s, and consequently command a greater cost. The study did not collect data directly bearing on this point. However, the number of years since the PI received a Ph.D. degree can be a proxy measure for academic rank. Sixty-seven percent of the P01 PIs

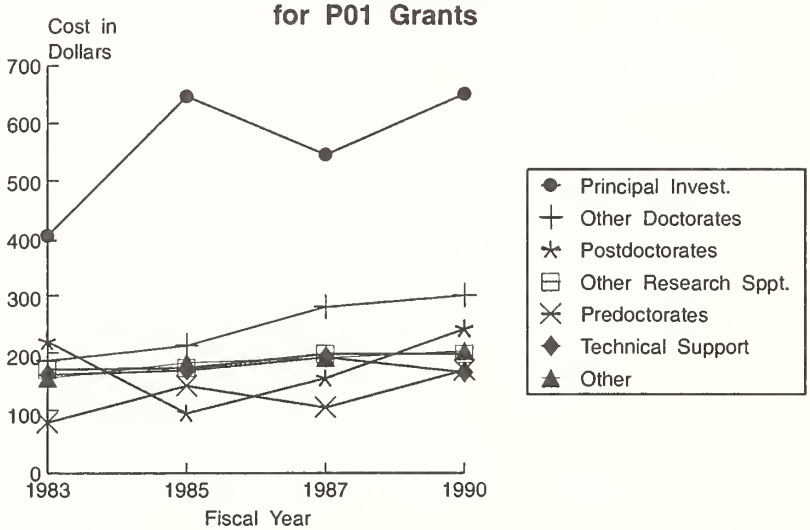
[5] Source: Consolidated Grant Application File, special analysis, November 25, 1992.

Figure 3. Average Cost of Each 1 Percent of Effort per Staff Category for R01 Grants



Source: NIH Grants Management File
Awarded Costs in Current Dollars

Figure 4. Average Cost of Each 1 Percent of Effort per Staff Category for P01 Grants



Source: NIH Grants Management File
Awarded Costs in Current Dollars

who hold a Ph.D. have held it at least 15 years.[6] These results suggest that PIs on P01s cost more because they are M.D.s, are senior Ph.D.s, or both.

The range of costs for individuals in the remaining personnel categories is rather narrow, but it is noteworthy that predoctorates and postdoctorates are toward the bottom of the scale. Unit cost of effort increases for PIs occurred much faster than increases for everyone else.

These results replicate and extend an earlier study which examined R01 grant awards for a sample of 1981 and 1985 awards for six ICDs. That study found "The increase in average compensation is greatest for the PIs" and that "The percent of total work time committed to a project by the PI has dropped slightly, while somewhat larger proportions are now requiring compensation for their services rather than contributing their time."[7] It found that volunteerism declined from 22 percent to 19 percent for PIs.

Table 6 shows the percent of volunteers on R01 and P01 grants in the present study. Volunteerism for PIs declined from 20 percent in 1983 to 19 percent in 1985, 17 percent in 1987, and 13 percent in 1990 for R01 grant awards. Volunteerism for the Other Doctorates category peaked in FY 1987, and sharply dropped thereafter. There was a sharp decrease in PI volunteerism for P01s in FY 1985 and FY 1987, followed by restoration to earlier levels in FY 1990. The Other Doctorates category, however, has declined monotonically from 43 percent in FY 1983 to 24 percent in FY 1990. Thus, the overall trend noted previously has continued. Volunteerism is down.

Pre- and postdoctorate costs

One issue of interest is the cost of pre- and postdoctoral individuals of NIH-supported research grants. Table 7 summarizes this information for these two groups of individuals in terms of (a) average cost per grant and (b) the estimated full-time cost. Estimated full-time annual cost (cost calculated as if the average individual were employed at 100 percent effort) for predoctoral individuals in the FY 1990 sample, for example, was calculated by dividing the cost by the FTE (e.g., $6,094/.406 = $15,012).

---

[6] These results were obtained by matching the samples in the study against information retrieved from the Doctorate Record File.

[7] *Changes in Research Project Participation and Compensation Patterns in Competing R01 Awards to Institutions of Higher Education (1981 and 1985)*, Program Analysis Note No. 11, National Institutes of Health, Office of Program Planning and Evaluation, July 1986, p. 1.

The remaining calculations were done the same way. Cost information here excludes fringe benefits.

Table 6
Volunteerism on Type 1 and Type 2 Grants

LABOR CATEGORY	Percent Volunteers on R01 Grants			
	FY 1983	FY 1985	FY 1987	FY 1990
PI	20%	19%	17%	13%
Other Doc.	24%	30%	36%	22%
Other Res. Suppt.	5%	7%	7%	6%
Technical Suppt.	3%	2%	2%	1%
Other	2%	3%	1%	0%
Unclassifiable	33%	100%	0%	0%
Overall	13%	15%	18%	11%

LABOR CATEGORY	Percent Volunteers on P01 Grants			
	FY 1983	FY 1985	FY 1987	FY 1990
PI	24%	10%	13%	22%
Other Doc.	43%	36%	26%	24%
Other Res. Suppt.	10%	9%	7%	7%
Technical Suppt.	1%	0%	3%	0%
Other	3%	0%	5%	6%
Unclassifiable	0%	0%	0%	0%
Overall	24%	18%	16%	15%

Predoctorates rose from an average of .286 FTE per grant in FY 1983 to .454 in FY 1985, dropped to .298 in FY 1987, and rose to an average .406 in FY 1990. Over the period, predoctorates went from 10 percent to 12 percent of all FTEs supported, and their unit cost of effort rose from $119 to $150. Utilization of postdoctorates showed a large monotonic increase from an average .051 FTE per grant in FY 1983 to an average .386 in FY 1990. Over the period, postdoctorates went from 2 percent to 12 percent of all FTEs supported, and their unit cost of effort rose from $139 to $192. Since predoctorates and postdoctorates were at the lower end of the wage scale compared with the other personnel categories, and since they carried out a greater percentage of the effort, from 12 percent of the

FTEs supported in FY 1983 to 24 percent in FY 1990, it is evident that with their increased utilization greater reliance was placed on a less expensive labor force.

Table 7
Average FTE, Percent of Total FTEs, Cost, and Estimated Full-Time Cost for Pre- and Postdoctorate Individuals of Research Grants in Study Samples

	FY 1983	FY 1985	FY 1987	FY 1990
PREDOCTORATES				
FTEs	.286	.454	.298	.406
% of Total FTEs	10%	14%	10%	12%
Cost	$3,396	$5,759	$5,068	$6,094
Full-Time Cost	$11,861	$12,693	$17,018	$15,012
POSTDOCTORATES				
FTEs	.051	.136	.214	.386
% of Total FTEs	2%	4%	7%	12%
Cost	$707	$2,291	$3,448	$7,399
Full-Time Cost	$13,935	$16,837	$16,130	$19,171

Summary

In summary, six major issues were addressed in this study: (1) the distribution of full-time equivalents (FTEs) among personnel categories in the workforce on NIH-funded grants; (2) the number of FTEs in pre- and postdoctoral training phases of their careers supported on these grants; (3) the level of effort for individuals in all personnel categories; (4) trends in total direct costs awarded for R01 and P01 research grants between FY 1983 and FY 1990, both in terms of constant and current dollars; (5) factors that have contributed to this pattern of change; and (6) changes in awards associated with the various personnel categories and subcategories and their contribution to the pattern. The major findings that emerged are as follows:

- The estimated number of FTEs supported by NIH funds increased from 47,895 in FY 1983 to 55,656 in FY 1985, dropped to 53,858 in FY 1987, and subsequently rose to 55,480 in FY 1990. The estimated average FTEs per grant increased from 2.99 to 3.25, dropped to 3.06, and rose to 3.33 in the same period.

- Over the years, there were small changes in estimated FTEs for Principal Investigators (from .34 FTE per grant to .37). Estimated FTEs for more senior doctorates increased (from .84 FTE per grant to 1.08). Major growth occurred for individuals in the postdoctoral training phase of their careers (from .05 estimated FTE per grant to .40). There were simultaneous decreases in the estimates for Technical Support (from .66 FTE per grant to .46) and Other (from .15 FTE per grant to .13) personnel categories.

- Estimates of FTEs supported by NIH funds for individuals in the predoctoral phase of career development increased nonmonotonically from 4,580 in FY 1983 to 6,762 in FY 1990, representing an increase from 10 percent of the total estimated FTEs in FY 1983 to 12 percent in FY 1990.

- Estimates of FTEs supported by NIH funds for individuals in the postdoctoral phase of career development increased from 811 in FY 1983 to 6,429 in FY 1990, representing an increase from 2 percent of the total estimated FTEs supported in FY 1983 to 12 percent in FY 1990. These estimates are suggestive rather than definitive because the classification definitions were arbitrary and because a substantial number of cases could not be classified.

- Total **direct costs** awarded, expressed in current dollars, increased faster for R01s than for P01s. Between FY 1983 and FY 1990 there was a 53 percent increase in **current dollars** awarded for R01s and a28 percent increase for P01 grants. Still, the purchasing power of the research dollar has been eroding. Total direct costs awarded, expressed in **constant dollars**, declined since FY 1985 for the R01s, and since FY 1983 for the P01s.

- Personnel costs were the single most important factor in the overall budget increases recorded. Compensation for PIs, without a concomitant increase in effort, was a driving factor.

Appendix: Methodology

Investigator-initiated research project grants (R01) and program project grants (P01) were selected for the study because they represent the most common and homogeneous group of grant mechanisms in the NIH portfolio. Approximately 65 percent of all awards made in FY 1990, the most recent year for which data are available, are R01s and P01s while approximately 80 percent of awards for Research Project Grants (RPG) fall into these two categories. Small Business Innovative Research (SBIR) grants, First Investigator Research Transition (FIRST) awards, and Method to Extend Research in Time (MERIT) awards together represent the remaining mechanisms in the research project category.

Competing R01s and P01s were selected for the project in order to reduce excessive variability that could result from examining grant types as heterogeneous as SBIR awards of approximately $50,000 in Phase I and $500,000 in Phase II, FIRST awards with a 5-year limit of $350,000, and MERIT awards that can be made for up to 7 years. It was also decided to examine both Type 1 (new) and Type 2 (renewal) grants to provide a more complete picture.

A 5-percent proportionate random sample was selected as representative of the NIH total. Five percent was used because it was judged to meet the requirements of statistical precision within the accelerated timeframe of the study. Because the total number of P01s awarded in any year is small, each Institute, Center, or Division (ICD) was assigned 5 percent of the yearly total or a minimum of one. In all but two cases ICDs were assigned one P01; in the two instances the ICDs were assigned two P01s. The following table summarizes the number of individual grants and projects contained in the various samples for this study.

A representative from each ICD grants management office was provided with a random list of grants, proportionate to the ICDs' share of R01s and P01s in the total NIH portfolio. The list contained more grants than would be needed for the study so that a replacement could be identified if a particular file was not available.

In order to standardize data collection procedures, participants were instructed in the purpose of the study, the use of a preprinted data sheet, and procedures to be used in adding new grants in the event that a file was missing or unusable.

Number of R01 and P01 Grants in the OMB Staffing Pattern Study

		FY 1983	FY 1985	FY 1987	FY 1990
R01	Type 1	122	82	115	40
	Type 2	97	171	125	132
	TOTAL R01	**219**	**253**	**240**	**172**
P01	Type 1	8	9	12	11
	Type 2	9	11	12	12
	TOTAL P01	**17**	**20**	**24**	**23**
	TOTAL GRANTS	**236**	**273**	**264**	**195**

Coding sheets contained information from NIH's centralized data system IMPAC on the PI, total requested costs, total costs awarded, and awarded costs by category (personnel, equipment, supplies, etc.). Grants management staff recorded staffing patterns in terms of the number of different individuals within each staff category defined below, levels of effort, and salaries. Volunteers at no cost were recorded at their level of effort and zero cost. Awarded and requested costs for each budget category were recorded from original grant file information. Grants management staff corrected the IMPAC data and provided backup documentation for doing so when the IMPAC data were found to be wrong.

Analysis of staffing patterns was aided by the development of criteria associated with staff in each of five categories:

- Principal Investigator — the one individual with fiscal and scientific responsibility for the project;

- Other Doctorates — staff with terminal professional degrees (e.g., Ph.D., M.D., D.D.S., D.V.M., D.O.) other than the Principal Investigator;

- Other Research Support Staff — professionals without doctoral degrees (e.g., nurses, computer programmers, data entry clerks, research assistants);

- Technical Support Staff — technicians, animal care workers, glassware washers, et cetera; and

- Other Staff — secretarial, clerical, or staff not classifiable in the other categories.

The number of years past the attainment of the first terminal degree was coded, when available, for each of the individuals in the Other Doctorates category. This information was subsequently used to form two subgroups, one of individuals with 7 years or less of experience (i.e., likely postdoctorates) and one of individuals with more than 7 years of experience (i.e., likely independent scientists). In 18 to 21 percent of the cases, this information was unavailable. In addition, coders were instructed to search for documentation that would identify individuals included in the Other Research Support category as being predoctoral students. Specific documentation included (a) evidence of tuition remission from the grant; (b) the use of "predoctoral" as a title on the budget page; and (c) a written statement that the individual was a predoctoral student.

The study was completed in two phases. Phase I consisted of data obtained from R01s only for FY 1985 and FY 1990 while Phase II consisted of data collected from R01s and P01s for FY 1983 and FY 1987 and for P01s for FY 1985 and FY 1990. The earliest year for data collection, FY 1983, was chosen because its records were the earliest records accessible without exhumation from the file repository. Data were entered manually into databases titled OMB1 and OMB2, each corresponding to one of the two phases of the study. All data entry was verified using a double entry procedure. Analyses were completed using Statistical Analysis System programs.